STATUS OF MINERAL RESOURCE INFORMATION FOR THE ISLETA INDIAN RESERVATION, NEW MEXICO

By

C. H. Maxwell
U.S. Geological Survey

M. H. Hibpshman
U.S. Bureau of Mines

Administrative report BIA-27

1976

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SUMMARY AND CONCLUSIONS

Mineral resources that have been produced on the Isleta Indian Reservation are scoria, sand and gravel, gold, and minor quantities of fluorite, lead, copper, silver, and stone.

The Precambrian rocks in the Manzano Mountains, especially the Greenstone complex, are potential hosts for economic concentrations of disseminated or massive sulfide deposits containing one or more of the following elements: lead, zinc, copper, nickel, cobalt, silver, gold. Many small prospect pits have been dug on small shows of mineralization and, although no significant deposits have yet been found, the presence of the mineralization suggests the possibility of larger deposits. Gold and copper bearing veins in the Precambrian have been mined in the past and, along with possible new finds, may be worked in the future. Epithermal vein systems in the Precambrian and in the Pennsylvanian rocks contain fluorite, barite, galena, and sphalerite in known workings. Other such economic deposits may be present. The oil and gas potential on the reservation is apparently low. A reconnaissance sampling and mapping program is recommended for future study.

INTRODUCTION

This report was prepared for the U.S. .Bureau of Indian Affairs by the U.S. . Geological Survey and the U.S. .Bureau of Mines under an agreement to compile and summarize available information on the geology, mineral resources, and potential for economic development of certain Indian lands. Source material included published and unpublished reports, and personal communication. There was no field work.

The Isleta Indian Reservation (Figure 1) is in parts of Bernalillo, Torrance, and Valencia Counties in central New Mexico. Reservation boundaries encompass a total of 210,948 acres. Mineral rights are owned mostly by the Indians but the Federal Government retains the mineral rights for gold, silver, and quicksilver (mercury) on two large land grants (Figure 1). All Indian land on the reservation is tribally owned. There are no allotted lands and private land holdings within the reservation are scattered. Mineral rights not owned by the tribe are listed in Table 1.

According to the U.S. .Department of Commerce (1974, p.~50) the population of the Isleta Indian Reservation is 1,783 . The Department of Commerce Census of Population for New Mexico (1970) gives the population of Isleta, the main village on the reservation, as 1,080. The Santa Fe Railroad (AT and SF) crosses the reservation in a north-south direction; Interstate Highway I-25 parallels part of the railroad. Access to the eastern and western parts of the reservation is by BIA roads. Albuquerque (243,751) is about 15 miles north of the reservation; and Belen (4,823) is about 10 miles south of the reservation adjacent to I-25.

The reservation is a nearly rectangular area situated along the Bernalillo-Valencia County line about 15 miles south of Albuquerque. The Rio Grande divides the reservation at about the east-west center line, and the Rio Puerco forms the western boundary (Figure 1). The western half of the reservation is a relatively featureless plain, broken only by a few volcanic cones. Wind Mesa,

the largest of the volcanic features, covers about a square mile and rises about 450 feet above the surrounding area. The land becomes broken and drops rapidly toward the Rio Puerco. The eastern half of the reservation is also a nearly featureless plain west of the Manzano Mountains, which rise about 3,000 feet above the plain near the eastern boundary.

PREVIOUS WORK

Geologic reports on the region around Albuquerque, New Mexico, with specific descriptions and maps of parts of the Isleta Reservation date back to 1898 when C. L. Herrick wrote "Papers on the geology of New Mexico," and, with D. W. Johnson, "The geology of the Albuquerque sheet" (1900). Kirk Bryan followed with "Geology of the vicinity of Albuquerque" (1909). These reports were concerned with the Tertiary and Quaternary rocks in the Rio Grande Trench, with emphasis on the Santa Fe Formation .Later reports refining this early work include those by Bryan and McCann in 1937 and 1938, and by Wright in 1946. More recent work on the Santa Fe Formation, mostly adjacent to the north side of the reservation, is a Ph. D. thesis from the University of New Mexico by P. W. Lambert (1968). Some aspects of the geology of the Manzano Mountains were mentioned in many early reports but no comprehensive data were available until Parry Reiche's excellent report in 1949 . More recent detailed mapping by Myers (1966, 1969) and Myers and McKay (1970, 1971) cover all of the Manzano Mountains part of the reservation.

TABLE 1

Areas on Isleta Indian Reservation where the mineral rights are not owned by the Indians

Owner	Location Section, Township and Range	Minerals owned
United States Government	Gutierrez and Sedillo Grants*	Gold,silver,mercury
Do	Lo de Pedilla Grant*	Do.
St. Johns Episcopal Church Albuquerque	195 acres patented claim in NE¼ SE¼, sec. 29, T. 8 N., R. S E.	All
Florence Gunnel estate	19.5 acres patented claim in SE¼, sec. 20, T. 8 N., R. 5 E.	Do.
Unknown	17.3 acres patented claim in NW¼, sec. 20, T. 8 N., R. 5 E.	Do.
Do	62.15 acres patented claim in C½, sec. 5, T. 8 N., R. 5 E.	Do.
Do	15 claims in secs. 15 and 1.6 T. 7 N., R. 2 E.**	Do
Do	SE¼, sec. 6, T. 7 N., R. 4 E.***	Do.
Do	SW¼ SW¼, sec. 9, T. 8 N., R. 6 E.	Do.
Do	W½ SW¼ SW¼, sec. 4 and SW¼ NW¼ SW¼ sec. 4	Do.

*Includes all lands within the grants on the reservation.

**As described in BIA Records. The number of acres in claims is unknown.

***Area called Aragon Springs.

PHYSIOGRAPHY

Most of the Isleta Reservation is in the Rio Grande structural trench. The trench was filled with debris during the Tertiary and was relatively stable during early Pleistocene, when the nearly level plain of the Ortiz pediment was formed (Wright,1946). The pediment gravel and caliche soil in the western part, along the Ceja del Rio Puerco (Bryan and McCann, 1937) are remnants of the Ortiz pediment. The Rio Grande and tributaries began to dissect the Ortiz pediment; several periods of stability occurred and more pediment plains were formed: the La Bajada-Tio Bartolo pediment at the base of the Manzano Mountains, the Segundo Alto surface, along the west side of the Rio Grande, and several others not well developed in the Isleta area. The dissection continued to the present configuration. West of the Rio Puerco the trench boundary is a series of fault blocks stepping up to the Colorado Plateau. To the east the trench boundary is the Manzano Mountains, characterized by a bold steep western front rising 2,000-3,000 feet above the pediments, then gradually sloping eastward to the Estancia plain.

GEOLOGY

General

Most of the Isleta Reservation lies in the Rio Grande valley; the valley fill consists of slightly consolidated gravel, sand, and clay, with interbedded and capping basalt flows. Terrace gravels, sand, silt, caliche, and soil cover most of the upland part of the valley, and clay, silt, and loam occupy the floodplains of the rivers. The easternmost part of the reservation includes parts of the Manzano and Manzanito Mountains, composed of Precambrian schist, greenstone, and granite overlain by Pennsylvanian and Permian arkose, sandstone, limestone, and shale. The distribution of the rock units on the Isleta Reservation is shown on the generalized geologic map (Figure 2).

Stratigraphy

Precambrian Rocks

General.--Precambrian rocks crop out only along the base of the Manzano Mountains. They are predominantly low to medium grade metasedimentary and metavolcanic rocks; compositional layering, foliation, and schistosity all trend northeast with southeast dips of 60° to 70° in the northern part of the reservation, swinging around to a northwestern trend and dips of 40° to 70° to the southwest in the southern part.

The metamorphic rocks are intruded by small bodies of pink, medium to coarse-grained granite along the northern boundary and are intruded by the Ojito biotite granite stock in the southern part.

Greenstone Complex.--The greenstone complex, the oldest rock unit in the area, is composed largely of dark green, and greenish-black to light olive green, massive, aphanitic and fine grained greenstone, with lenticular and tabular bodies of chlorite schist and phyllite, and local layers of gray, black, and lavender carbonaceous slate, buff siltstone, and thin lenses of quartzite, conglomerate, and andesitic metatuff (Reiche, 1949). Unless the unit has been repeated by folding and faulting, thickness is as much as 22,000 feet. The greenstone appears to be mostly a metabasalt or basaltic andesite and includes local lenses of agglomerate and flow breccia. It grades upward into a thick sequence of metatuff (the Lacorocah metatuff member of Reiche, 1949), which crops out along the northern contact of the greenstone complex. The metatuff is light gray, crudely bedded, and weakly schistose, with local lenses of conglomerate or breccia with flattened fragments of metatuff in a similar but fine grained matrix. Two types of chlorite schist are included in the Greenstone Complex, one probably resulted from the dynamothermal metamorphism of the greenstone, the other from the metamorphism of shale and silt beds. They are difficult to distinguish in the field. The buff siltstone and schist in some localities appears to be altered along shear zones; the alteration may be related to mineralizing fluids.

Fractures in the massive greenstone have been stained by secondary copper minerals in some local zones. The more schistose parts, the metatuff, and some of the chlorite schist and phyllite contain local disseminations of sulfide minerals.

Phyllite and schist.--(Lower Metaclastic Series of Reiche, 1949).--The phyllite and schist unit is

predominantly shiny-weathering silver gray and gray, fine and medium-grained phyllite and schist with interbedded brown micaceous argillite. Lenses and beds of white, gray, and red quartzite are locally common. Interbedded greenstone and amphibolite occur near the top of the unit. A metatuff is interbedded with schist and phyllite in a few small outcrops in the westernmost exposures. The unit may have an aggregate thickness of as much as 9,600 feet. Pink to dark brown metarhyolite (Sevillita Rhyolite or Stark and Dapples, 1946) crops out in small areas along the northern boundary of the reservation and is included in the phyllite and schist map unit. It is schistose to gneissic, fine to coarse grained, siliceous, with micaceous laminae. Aplite and rhyolite dikes are locally common in the schist and in, or associated with, the metarhyolite.

Pink, medium to coarse-grained granite crops out in and near the metarhyolite along the northern boundary of the reservation. It is similar in appearance to the rhyolite dikes but coarser grained and in larger masses.

Biotite granite.--The Ojito Stock of Reiche (1949), a gray, massive, medium-grained biotite soda-granite, makes up most of the Precambrian in the southern part of the reservation. The contact with the Greenstone Complex is steeply discordant, with locally abundant xenoliths of greenstone in the border zone, and with minor silicification of the greenstone along the contact.

Pennsylvanian Rocks

General.--Sedimentary rocks of Pennsylvanian age overlie the smoothly eroded surface of the Precambran rocks. In adjacent areas small relict lenses of calcareous rocks of Late Mississippian age (Armstrong, 1967) occur between the Pennsylvanian and the Precambrian but are not mapped separately. The Pennsylvanian rocks are part of the Magdalena Group and have been divided into an upper and a lower map unit on Figure 2.

Lower unit.--The lower map unit includes the middle Pennsylvanian Sandia Formation at the base and the overlying lower part of the Madera Limestone. The Sandia Formation is composed predominantly of olive-gray and brownish-gray siltstone, sandstone, and conglomerate, with minor beds of gypsiferous shale. A basal conglomerate containing white quartzite cobbles is locally present at the base of the unit. The upper 20 feet is light to medium gray unevenly bedded, sandy to shaly limestone containing some brown chert and partings of shaly siltstone. The Sandia ranges from about 90 to 320 feet thick. The lower part of the Madera Limestone, also Middle Pennsylvanian in age, is composed of cliff-forming beds of gray limestone which contain varying amounts of black to brown chert and minor amounts of gray to black shale, calcareous siltstone, and channel-fill deposit., of grayish orange conglomerate and sandstone. A persistent bed of pale orange sandstone about 8 to 20 feet thick is present about 140 feet below the top of the unit. The lower part is shaly at its base and grades into the underlying Sandia Formation. The lower part of the Madera is about 600 ft thick.

Upper unit.--The upper map unit is entirely Madera Limestone of Upper Pennsylvania age. It is made up of three units or cyclothems, each about 200 ft thick, composed of a similar sequence of beds; basal channel fill deposits of grayish-orange crossbedded conglomerate, arkose, and sandstone

grading upward into gray shale with lenses of sandstone and shale. The gray shale grades upward into calcareous shale and limestone and into about 60 ft of light olive gray cliff- or ledge-forming limestone. Only the lowest part of the third or upper cyclothem occurs on the reservation, along the south-eastern boundary.

Permian Rocks

Rocks of Permian age crop out in an up-faulted block on the pediment surface in the eastern part of the reservation (Figure 2).

Abo Sandstone.--Several hundred feet of Abo Sandstone consists of dark red siltstone and sandstone, flagstone, and ripple marked sandstone beds.

Yeso Formation.--The Yeso Formation consists of orange-red siltstones and sandstones and minor white sandstone, and is about 1,200 feet thick.

San Andres Limestone.--Only a few feet of San Andres limestone is exposed in two small outcrops (Figure 2). It is massive yellowish brown weathering limestone. Glorieta Sandstone, yellow and buff, well bedded, friable sandstone with low angle crossbedding a few tens of feet thick is in the northern outcrop.

Tertiary Rocks

Santa Fe Formation.--The Santa Fe Formation is an accumulation of late Tertiary, deformed, slightly consolidated basin deposits occupying the Rio Grande depression in the western three quarters of the Isleta Reservation (Wright, 1946). The best exposures are on the flanks of valleys or mesas capped by basalt or caliche; along the Rio Grande valley, along the Rio Puerco, and east of Wind Mesa. The Santa Fe Formation on the reservation consists of alluvial fan, playa, and axial stream deposits of buff, pink, white, and tan sand and silt with numerous layers of gray gravel toward the top, which becomes much thicker east of the Rio Grande. The top 10 feet is cemented into massive caliche. About 300 feet is exposed.

Basalt flows are interbedded with the Santa Fe Formation at several localities (Figure 2). near and west of Isleta.

Quaternary Rocks

Rocks of Quaternary age include pediment gravels overlying the Santa Fe Formation, scoria cones, and basalt flows overlying the Santa Fe and (or) the pediment gravels, and recent river valley alluvium and windblown sand and silt. Most of the western two-thirds of the reservation is covered by alluvium and sand dunes.

Structure

Several thrust or reverse faults and some probable folds in the Precambrian rocks have been recognized as Precambrian in age (Reiche, 1949).

Westward dipping thrust faults of probable Laramide age are conspicuous in the Manzano Mountains. Two major ones are shown on Figure 2 where the Precambrian is thrust at least 2,000 feet up and over the Madera limestone. Most normal faults are later and may have recurrent movement into the Quaternary. A few of the major north and northeast trending Tertiary faults are shown on Figure 2.

The eastern boundary of the Rio Grande

Trench is largely covered by Quaternary pediment gravels but probably occurs just west of the Manzano Mountains. The north-south trending faults on Figure 2 are part of the trench edge, where recurrent movements have made the faults visible in the late Tertiary and recent valley fill materials. The faults on the west side of the reservation are part of a zone which makes up the western edge of the Rio Grande Trench.

The Tertiary fill in the Rio Grande Trench is at least 6,300 feet thick (Reiche, 1949), and projection of the sedimentary rocks in the Manzano Mountains indicate a total downward displacement in the trench of at least 10,000 feet.

MINERAL RESOURCES

General

Both metallic and nonmetallic mineral resources occur on the reservation. Energy resources have not been discovered, although most of the reservation has been leased for oil and gas exploration.

The Precambrian rocks in the Manzano Mountains, especially the Greenstone Complex, are potential hosts for economic concentrations of disseminated or massive sulfide deposits containing one or more of the following metals: lead, zinc, copper, nickel, cobalt, silver, gold.

Epithermal vein systems in the Precambrian and Pennsylvanian rocks in the area contain fluorite, barite, galena, and sphalerite in known workings. Other economic deposits may be present.

Significant mineral production to date has been confined to scoria (volcanic cinders), and sand and gravel. Other, less significant, mineral production includes gold, silver, copper, lead, fluorite, stone and clay. Currently, only scoria and a minor amount of clay are being produced.

Energy Resources

Exploration for energy resources thus far has been unsuccessful on the reservation. However, Shell Oil Co. has leased nearly the entire reservation west of the Manzano Mountains for oil and gas exploration. Rocks of the Santa Fe Formation could be hosts for uranium minerals, although no discoveries have been recorded to date. Coal is not known on the reservation. Carbon dioxide has been produced from wells about 10 miles east of the reservation.

Neither oil nor natural gas have yet been found within the reservation. In 1975, Shell Oil Co. drilled one exploratory well in NW ¼ NW ¼ sec. 7, T. 7 N., R. 2 E., to a depth of slightly over 16,000 feet. No oil and gas were found. The Shell Oil Go. is re-evaluating the area, but they have no definite plans for further exploration at this time. The U.S. Geological Survey rates those areas on and near the reservation, which are listed in. Table 2, as prospectively valuable for oil and has. The nearest producing oil and gas field is in sec. 33, T. 18 N., R. 3 w. about 60 miles north of the reservation (USGS oral commun., 1976).

TABLE 2

Areas on the Isleta Indian Reservation prospectively valuable for oil and gas*

Sections	Township	Range
3-10, 15-22, 27-36	7 N	1 W
28, 31-33	7 N	1 E
1-16, 21-28, 32-36	7 N	2 E
All	7 N	3 E
1-23	7 N	4 E
1-11, 14-23, 24-28	8 N	1 W
25, 36	8 N	1 E
1-8, 12, 13, 23-36	8 N	2 E
All	8 N	3 E
Do	8 N	4 E

*Source.--U.S. Geol. Survey Area Office, Roswell, New Mex.

In addition to the Shell Oil dry hole, several other exploratory wells, all dry, were drilled on and near the reservation between 1926 and 1939 by various operators (Table 3).

TABLE 3

Oil and gas exploratory wells on and near the Isleta Indian Reservation

Operation	Date	Location	Formation tested	Depth
Shell Oil Co.*	Oct. 1974 to April 1976	NW¼NW¼ sec 7 T. 7 N., R. 2 E.	Wolf Camp (Lower Permian)	16,346
Valencia Petroleum Co.	May 1926 to Nov. 1927	NE¼SW¼ sec.32 T. 7 N., R. 2 E.	Unknown	2,144
Swisher and Wallace	Dec. 1926 to April 1927	NW¼NW¼ sec.25 T. 7 N., R. 2 E.	Unknown	1,976
Perrin and Swisher	June 1925	NW¼NW¼ sec.25 T. 7 N., R. 2 E.	Unknown	1,405
Dalies	March 1951 to May 1952	SE¼SE¼ sec. 32 T. 7 N., R. 1 E.	Dakota	7,955
Joiner Oil Corp.	Jan. 1935 to Oct. 1939	SE¼NW¼ sec.23 T. 7 N., R. 1 E.	Unknown	5,608

*The only well drilled within reservation boundaries.

Nonmetallic Mineral Resources

General

Nonmetallic mineral resources include scoria (volcanic cinders), sand and gravel, stone, fluorite, barite, gem stones, and clay (Figure 3). To date, only scoria and sand and gravel have been produced in significant quantities. Fluorite, barite, and stone have been produced in minor amounts. Current production is limited to scoria and very minor amounts of clay.

Scoria

Scoria, locally called volcanic cinders or cinders, has been produced from volcanic cones on the reservation for several years. Most of the material evidently is used for landscaping, but some is used as road metal (base). A series of volcanic cones occurs in Tps. 8 & 9 N., R. 1 E. Present and past production is from cones in E ½ sec. 18, SW ¼ SW ¼ sec. 20, and SW ¼ SW ¼ NW ¼ sec. 29, T. 8 N., R. 1 E. (Figure 3).

Current production is from a single quarry by Rocky Mountain Stone Co. of Albuquerque. The material is ripped with bulldozers, crushed and sized. Royalty payments to the tribe are $0.25 per ton of material less than 6 inches in diameter and $2.00 per ton of material greater than 6 inches in diameter. Reserves are adequate for years of production.

Sand and Gravel

Sand and gravel is abundant and has been produced from deposits within the area for many years. Locations of known sand and gravel pits are listed in Table 4 and are shown on Figure 4. All sand and gravel leases have expired or will expire during 1976. Sand and gravel reserves are large.

Royalties for sand and gravel have ranged between $0.05 and about $0.15 per cubic yard. At least one contract called for a royalty payment of $0.10 per ton, which would be about $0.15 per cubic yard. In addition to the tonnage royalty, the tribe usually requires an advance royalty payment on sand and gravel that can be applied against production. The amount of the advance royalty payment is negotiable. Recently the tribe has been reluctant to grant new permits or extend existing ones. The low royalty and the small production of many of those operations producing sand and gravel on the reservation may be the reason for the tribal disinterest. A 5- or 10-cent per ton royalty would require large tonnages to be removed before the tribe would gain a significant return for its sand and gravel.

TABLE 4

Sand and gravel pits on the Isleta Indian Reservation

Lessee	Location Section	Township	Range	Acres
Dorn Construction Co.	15 & 16	8 N	2 E	15
Brown Construction Co.	NE¼N½SE¼ 4	8 N	2 E	240
N. Mex. State Highway Comm.	NE¼ 24	8 N	2 E	2.87
Do	SW¼ 27	8 N	2 E	Unknown
Do	4	7 N	2 E	5.5
Do	10	8 N	2 E	45
Unknown	NE¼SE¼ 15	8 N	2 E	Unknown
Stockton	6, 7 West of Interstate 25	8 N	3 E	76
Serda	6, 7 East of Interstate 25	8 N	3 E	76
Brown Construction Co.	SE¼ 32, W½ 33, NE¼ 33, SE¼ 28	8 N	3 E	100
N. Mex. State Highway Comm.	33	9 N	2 E	Unknown
Jack House*	9 & 16	8 N	5 E	8.5

*This lease was for quartz gravel. Royalty was $1.25 per ton; 206 tons were produced. The lease expired in September 1964.

Stone

General.--Schist has been produced from two small quarries and white quartz from one small pit. The quantity of stone produced probably was not more than a few tens of tons of either material; both probably were used for decorative purposes. Although limestone is present, none has been quarried.

Schist.--Schist has been quarried in NE ½ SE ½ sec. 17 and SE ½ NE ½ sec. 9, T. 8 N., R. 5 E. (Figure 3). Use of the stone is not known, but it was probably a facing for buildings in the Albuquerque area. The quantity of stone removed from both quarries probably did not exceed 50 to 100 tons. Reserves are extremely large, and could be a source of income to the tribe for many years if a market could be developed.

Quartz.--Several large quartz veins cut the schist in secs. 8, 9, 10, 15, 16, and 21, T. 8 N., R. 5 E. The quartz has been quarried in only one small pit in SW ¼ NW ¼ sec. 16, T. 8 N., R. 5 E. (Figure 3). It is snow-white and occurs in veins 5 to 20 feet wide, some of which extend for a mile or more. The material evidently was mined for building stone. Royalty was $1.00 per ton. Rocky Mountain Stone Co. produced the stone and paid an advance royalty of $200.00, but it is unknown how much quartz was produced. The rock is suitable for decorative stone, landscaping, and roofing. The quantity of quartz is quite large and market possibilities should be fair to good.

Limestone.--Limestone suitable for cement manufacture is present in E ½ Tps. 7 and 8 N., R. 5 E., and that portion of Tps. 7 and 8 N., R. 6 E., that is within the reservation. The limestone is the Madera Formation of Pennsylvanian age. The rock is identical to that quarried by Ideal Cement Co., at Tijeras, a few miles north of the reservation. Reserves are very large and could supply a cement plant if a company could be encouraged to locate on the reservation. However, tremendous quantities of similar material exist off the reservation and nearer to transportation and markets. Therefore, it is doubtful that a limestone quarry will be developed on the reservation.

Fluorite and Barite

Fluorite was mined from the Galena King mine as early as 1910. The mine is in E ½ sec. 8, T. 8 N., R. 5 E. (Figure 3). According to Williams (1966), no production has occurred from the property since 1927. The property originally consisted of five claims, two of which, the Octoroon and Nellie, were patented. Evidently the property was opened originally as a lead mine, as several carloads of lead ore were shipped (Talmage and Wooton, 1937; Williams, 1966). Johnston (1928) notes that several carloads of ore containing between 53 and 68 percent lead and 1.5 ounces of silver were shipped. One carload of fluorite was shipped to Pueblo, Colo. (Williams, 1966). The fluorite occurs with galena and barite. Williams (1966, p. 13) describes the mine as follows:

"Fluorspar (fluorite) occurs in a fault fissure vein that strikes north and dips 80° W in granite and limestone. The vein ranges rom a few inches to 2.5 feet in width and contains numerous cavities. The vein consists of granite breccia fragments coated and cemented with fluorite and small amounts of barite, quartz, calcite and galena. Fluorite also formed in well developed crystals intergrown with barite crystals.

"The mine was developed by a 300- to 400-foot adit and a 300-foot crosscut, which later followed the vein for 200 additional feet. A 100-foot-deep winze was sunk near the contact of the crosscut with the vein. All work was done by hand methods. Samples of small dumps near the portal of each working assayed 69.7 percent CaF_2, 8.8 percent SiO_2, 12.8 percent $BaSO_4$, and 2.1 percent $CaCO_3$."

Johnston (1928) indicates that all ore of commercial dimensions has been mined, prospect adits failed to reveal new ore bodies, and it is unlikely that the Galena King mine will be reopened. It is possible, however, that other deposits exist in the general area.

Gem Stones

Chalcedony, agate, and jasper occur in the western half of the reservation. The materials are particularly abundant near the western boundary and along the Rio Puerco. The tribe does not collect nor try to market the gem material at this time; if such an enterprise were attempted, large quantities of the materials are available.

Clay

Clay is produced in limited quantities by members of the tribe who are making pottery. Little is known of the properties of the clay used for pottery making except that it is light gray in

color and fires a light pink. The location and quantity of resources are unknown, but only a few tons of the material would be sufficient to last for years at the present rate of production.

Metallic Mineral Resources

General

Known metallic minerals on the reservation are limited to gold, silver, lead, copper, nickel, and molybdenum. The Hells Canyon district (T. 8 N., R. 5 E.) contains all the metallic mineral deposits. Gold and silver have been mined from veins, and copper and nickel occur in greenstone in the Manzano Mountains (Figure 5). Lead occurs with fluorite near the northern boundary. Molybdenum has been reported (Schilling, 1965). Only small quantities of gold, silver, lead, and copper have been produced.

Gold and Silver

General.--Gold and silver may have been mined during Spanish Colonial time. Reiche (1949) reports a legend of Spanish mining in the area based on the remains of an old arrastre (primitive grinding mill) near the existing Milagras mine. Minor quantities of gold and silver also may have been produced in the late l9th Century from what is now the Belvidere property.

Milagras Mine.--The Milagras mine, in SE ¼ NE ¼ sec. 29, T. 8 N., R. 5 E., was first operated in the 1880's. The original claim was patented in 1876 and now includes 19.9 acres (Figure 5). Reiche reports that 1,000 to 1,500 tons of gold ore was removed in the 1880's and 1890's. Value of the ore was about $5.00 per ton. Based on a $20.00 per ounce price, the average grade of the ore was at least 0.25 ounce per ton. Recently Canorex Corp., a Canadian-based company, recovered gold and silver from the property by surface mining and heap leaching. They operated the mine during the summer of 1975 and in the spring and early summer of 1976. The operator stated that the mineral occurred as free gold and that the grade of the ore averaged about 0.3 ounce of gold per ton. An article in the Northern Miner (Sept. 18, 1975) states that the average silver content was 0.63 oz/ton. Recovery from cyanide leaching was about 95 percent. The company president and operator indicated that the reason for closing the mine was a decrease in the price of gold from $140.00 to about $112.00 per ounce but a rise in price probably would allow him to reopen the mine. Any renewed operations would be by underground mining. The mine, as it now exists, is an open cut about 125 feet long and about 20 feet wide. One leach pad was used; on it was heaped 8,000 tons of ore. The gold was leached with cyanide solution and was recovered by percolating the leach solution over carbon rods.

Reiche (1949) indicated that originally the Milagras was a group of claims which included a narrow strip of placer ground to the west and one or more quartz lodes in the hills. No grade for the placers was given, and there is no evidence of placer mining anywhere near the property. Reiche (1949, p. 1207) describes the ore at the mine and the geology immediately south of the mine as:

> "...white to pale-yellow, highly porous quartz rock, from which, presumably, a high content of sulfides has been thoroughly leached. . . . Immediately south

> of the Milagras claim a plexus of quartz veins is shown in very generalized fashion on Plate 5. Only the northern vein on which the Milagras is opened is of the porous quartz; the others are of dense chalcedonic vein material, varying from white to red which grades into silicified zones in the chloritic country rock. The appearance of the whole suggests replacement rather than fissure filling."

Reiche did not indicate that a fault occurred in the area, but Myers and McKay (1970) show the mine to be located on a fault or shear that strikes northeast and dips 70° northwest.

The mine operator stated that the gold occurs in a very porous white quartz which appears to be hydrothermally altered (recrystallized) quartzite. The alteration is spotty, and much of the material on the leach pad was unaltered quartzite. There was no attempt to separate the gold bearing quartz from the barren rock and it was simply heaped together on the pad.

A 150-foot shaft was sunk in 1910 on the Star claim which originally adjoined the Milagras on the west but which is now part of the Milagras (Reiche, 1949). Nine carloads of ore containing $10/ton gold and 9 to 28 percent copper was shipped to the smelter at El Paso, Texas. Apparently the reason for closing the Star operation was water at 150 feet. No evidence of the shaft remains but one adit or crosscut is about 200 feet southwest of the Milagras mine. Little dump material is present; the workings are probably not extensive. Two small prospect pits snowing minor copper-oxide mineralization are on what is probably the property line just above the abandoned adit. Both are in the greenstone complex rather than on the fault.

No gold reserves have been reported from the Milagras mine. The operator of the Milagras stated that because gold does not occur consistently throughout the workings, more exploration (drilling) would be required before he could estimate reserves.

Belvidere Property--The Belvidere group of claims lies to the south of the Milagras (Figure 5). The property is made up of 13 claims, includes 195 acres, and is owned by St. John's Episcopal Church in Albuquerque. This group of claims may have yielded minor gold values in the 1880's (Bureau of Mines Memorandum, December 8, 1959, signed T. M. Romslo). The gold is present in quartz stringers and small pods. The International Uranium Corp. shipped about 300 tons of ore containing 1.5 percent copper and minor gold from the Belvidere property in 1955.

This property was widely advertised from 1959 to 1961 as a platinum mine, but failed to ship any platinum (Elston, 1967). It was the report of platinum on the property that prompted an examination in 1959 by T. M. Romslo of the Bureau of Mines. Pertinent parts of the examination report are as follows:

> "The operators suspected the presence of platinum on the property first by the physical characteristics of the gold buttons obtained from fire assays and the insolubility of the free gold in cyanide solutions. Spectrographic analyses and fire assays of the ores and concentrates for platinum were then made by several laboratories, including Ledoux & Co., Smith-Emery Co., New Mexico School of Mines and the Atomic Energy

Commission. They found none of the samples to contain other than trace amounts of platinum. Mr. Taylor, and his son Palmer, then reportedly developed a procedure for testing platinum-bearing ores. They claim that samples of Belvidere ore which were tested by this procedure were found to contain platinum, generally in significant amounts. However, perfecting the procedure continues since the platinum content of check assays show a wide difference. Meanwhile, plans are being made for the formation of another company which will be concerned with the construction of a plant for the production of platinum-group metals from Belvidere ore."

The ore values, from two samples of concentrate taken by Romslo, were calculated to be about 0.02 ounces gold and 0.02 ounces silver per ton with a trace of platinum. The mine was examined again by the Bureau of Mines in 1960. Six samples taken in the cuts from which the 300 tons of copper was mined gave the following results:

Sample No.		Gold Ounces/ton	Platinum Ounces/ton
16059	Top of hill, surface	0.005	Less than 0.01
16060	Open cut 60 feet from top of hill	0.03	Less than 0.01
16061	Open cut 150 feet from top of hill	0.025	Less than 0.01
16062	Open cut 250 feet from top of hill	0.04	Less than 0.01
16063	Open cut at bottom of hill	0.10	Less than 0.01
16064	Mill ore bin	0.005	Less than 0.01

It appears that the reports of platinum on the property were exaggerated. Results of the examinations indicate that there is only a remote likelihood of significant gold reserves on the Belvidere property.

Galena King Mine.--Silver was recovered from the Galena King mine at the time it was operated primarily for lead and fluorite. Several carloads of lead ore were shipped containing 1.5 ounces of silver per ton (Johnston, 1928). Reserves of silver ore at the Galena King are probably insignificant; Johnston indicates that ore at the mine has been exhausted. It is possible, however, that other silver bearing fluorite veins occur in the area. A more complete description of the Galena King mine and production from it is in the section on fluorite and barite of this report.

Lead

Lead occurs with fluorite and silver in a fissure vein near the northern border in E ½ sec. 8, T. 8 N., R. 5 E. The vein ranges from a few inches to 2.5 feet in width (Williams, 1966). A more complete description of the deposit appears in this report in the section on fluorite. Several carloads of lead ore were reported to have been shipped from the property between 1910 and 1928. Johnston (1928) indicates that the lead content of the ore from the mine was between 53 and 68 percent.

Copper

Copper is reported to have been produced in 1910 from the Star claim near the Milagras property (Figure 5) (Reiche, 1949). Nine carloads of sulfide ore were shipped from a 150-foot shaft. Water encountered in the shaft apparently caused suspension of the operation. The Star claim is reported now to be part of the Milagras property (Reiche, 1949), described in the section on gold.

Oxidized copper minerals occur in greenstone in the Manzano Mountains. On the Milagras claim, copper carbonates profusely stain greenstone above the open cut that resulted from the recent gold mining operation. The Milagras also may have been mined in 1948 under the name Manzano Gold mines. In 1948, 39 tons of ore containing 3,562 lbs of copper was shipped from the property (Bureau of Mines file). Copper carbonate minerals also stain the rock at the Belvidere mine, which is about a quarter of a mile south of the Milagras. Bureau of Mines investigations in 1959 and 1960 ascertained that about five carloads of ore was shipped to the El Paso and Douglas smelters, but the material was too low grade for profitable operation. The presumably oxide ore was mined by open cut. Copper oxide mineralization shows in two prospect pits (Figure 5) near the Milagras open cut; both prospects are believed to be on Indian land.

Nickel

The greenstone complex of rocks surrounding the Milagras and Belvidere claims contains nickel. A selected sample of-greenstone contained l.03 percent copper, 0.5 ounces silver per ton and 0.012 percent nickel. This nickel content is within the normal range for this type of rock.

Molybdenum

Minor quantities of molybdenite are reported by Schilling (1965) to occur with pyrite and chalcopyrite in quartz stringers in silicified Precambrian schist at the Star Lode and other prospects along Hell Canyon. There has been no production of molybdenum from the area.

MINERAL LEASING

Federal regulations require established royalty and rental fees for mineral leases on Indian reservations. Bonds must be posted by the lessee for each lease. Regulations pertaining to mineral leasing are found in the Code of Federal Regulations, Titles 25CFR and 30CFR.

Requirements for bonds are as follows:

For less than 80 acres	$1,000
For 80 acres and less than 120 acres	1,500
For 120 acres and not more than 160 acres	2,000
For each additional 40 acres, or part thereof, above 160 acre	500

The bond for minerals other than oil and gas may be less, provided that the Secretary of the Interior, with consent of the Tribe, agrees; or a lessee may file a bond of $15,000 for all leases in one State if the total acreage does not exceed 10,240. A lessee also may file a bond of $75,000 for nationwide coverage.

Lessees may acquire more than one lease, but a single lease may not exceed 2,560 acres for minerals other than coal. because no coal resources are known to exist on the reservation regulations pertaining to coal are not included. Leases may be made for any specified term not to exceed 10 years.

Rentals for minerals are set at $1.00 per acre per year and a development expenditure is required of not less than $10.30 per acre per year.

Unless otherwise authorized by the Commissioner of Indian Affairs, the minimum royalty rates for minerals are as follows:

"(a) For substances other than gold, silver, copper, lead, zinc, tungsten, coal, asphaltum and allied substances, oil, and gas the lessee shall pay quarterly or as otherwise provided in the lease, a royalty of not less than 10 percent of the value, at

the nearest shipping point, of all ores, metals, or minerals marketed.

(b) For gold and silver the lessee shall pay quarterly or as otherwise provided in the lease, a royalty of not less than 10 percent to be computed on the value of bullion as shown by mint returns after deducting forwarding charges to the point of sale; and for copper, lead, zinc, and tungsten, a royalty of not less than 10 percent to be computed on the values of ores and concentrates as shown by education returns after deducting freight charges to the point of sale."

In addition to the Federal regulations, the tribe requires that some Indians be hired by any firm extracting minerals from reservation lands.

The Federal regulations currently are being revised, and new regulations may be in effect for any future leasing activity.

MINERAL RIGHTS ON SPANISH LAND GRANTS WITHIN THE RESERVATION

The old Spanish land grants, the Lo de Pedilla and the Guiierrez and Sedillo, make up a large part of the Isleta Indian Reservation (Figure 1). The grants are owned by the tribe, but the United States retains the mineral rights for gold, silver, and quicksilver (mercury). None of the three commodities are known to occur within grant boundaries, but gold and silver have been found within the reservation just north of the Lo de Pedilla Grant. If gold or silver were discovered in the grant area, the tribe would derive no royalties from their production; the only payment to the tribe would be that gained from negotiated fees for surface disturbed. Accordingly, the tribe probably would have no interest in either mineral exploration or development of any gold, silver or mercury occurrences on lands within the two grants.

The Code of Federal Regulations, Title 43, subpart 3561, Gold and Silver in Confirmed Private Land Grants, indicates that only the tribe, as the owner of the land, has the right to lease from the U.S. Government such lands for gold, silver, and mercury production. The required 5 to 12.5 percent royalty due from any production would go to the United States.

Transfer of full mineral title, possibly through tribal petition, could remove U.S. royalty claims on the Lo de Pedilla and the Gutierrez and Sedilla Grants.

MAP SOURCES

The entire reservation is covered by U.S. Geological Survey 7.5-minute topographic quadrangles. The following is a list of the 7.5-minute maps.

Bosque Peak
Dalies
Dalies NW
Escabosa
Hubble Spring
Isleta
Los Lunas
Los Lunas SE
Mount Washington
Rio Puerco
South Garcia
South Garcia SE
Tajique
Wind Mesa

The Geological Survey has published three 7.5-minute geologic maps of the Manzano Mountains area. They are the Bosque Peak Geologic Quadrangle Map GQ 948, Escabosa Quadrangle GQ 795, and Mount Washington Quadrangle GQ 886.

In addition to the topographic and geologic maps listed, the Geological Survey has published State of New Mexico base maps as well as a geologic map of the State. All listed maps may be ordered from the U.S. Geological Survey, Branch of Distribution Central Region, Box 25286, Denver, Colo., 80225.

Another source of map coverage of the reservation is the U.S. Bureau of Land Management, which has published Master Title Plants covering each township, as well as surface management maps. Both the maps and the plats can be ordered from the Bureau of Land Management, record;. Section P.O. Box 1449, Santa Fe, N. Mex. 87501. An historical index can be obtained to accompany the Master Title Plats. The quadrangles, master title plats, and historical indexes should be ordered by township and range.

The New Mexico State Highway Department has county road maps available. Requests should be addressed to the New Mexico State Highway Department, Duplicating Services, P.O. Box 1149, Santa Fe, N. Mex. 87503. The New Mexico State Bureau of Mines in Socorro also is a good source of map information.

Aerial photographs of the reservation may be purchased from both the U.S. Geological Survey and the U.S. Department of Agriculture. Agencies within the Department of Agriculture from which photos may be obtained are the U.S. Forest Service and the U.S. Soil Conservation Service. Satellite imagery can be obtained from the U.S. Geological Survey, EROS Data Center, Sioux Falls, S. Dak. 57101.

RECOMMENDATIONS

The western two thirds of the reservation are underlain by sedimentary rocks that may contain oil and gas. Shell Oil Co. has leased this area and probably will test it. The eastern third of the reservation is underlain by Pennsylvanian and older rocks that contain known occurrences of sulfides. The geology of these occurrences is inadequately known and more field studies of these are warranted.

Recommendations for further mineral investigation are as follows:

1. Geologic mapping and geochemical sampling of the area underlain by the greenstone complex to determine the extent of sulfide mineralization.

2. Examine the Milagras property to determine whether there is evidence to support the existence of copper sulfide and gold below the surface as reported by Reiche (1949).

3. Reexamine Galena King mine area to determine if other veins exist.

4. Determine market possibilities of white quartz for use as roofing granules, decorative stone, etc.

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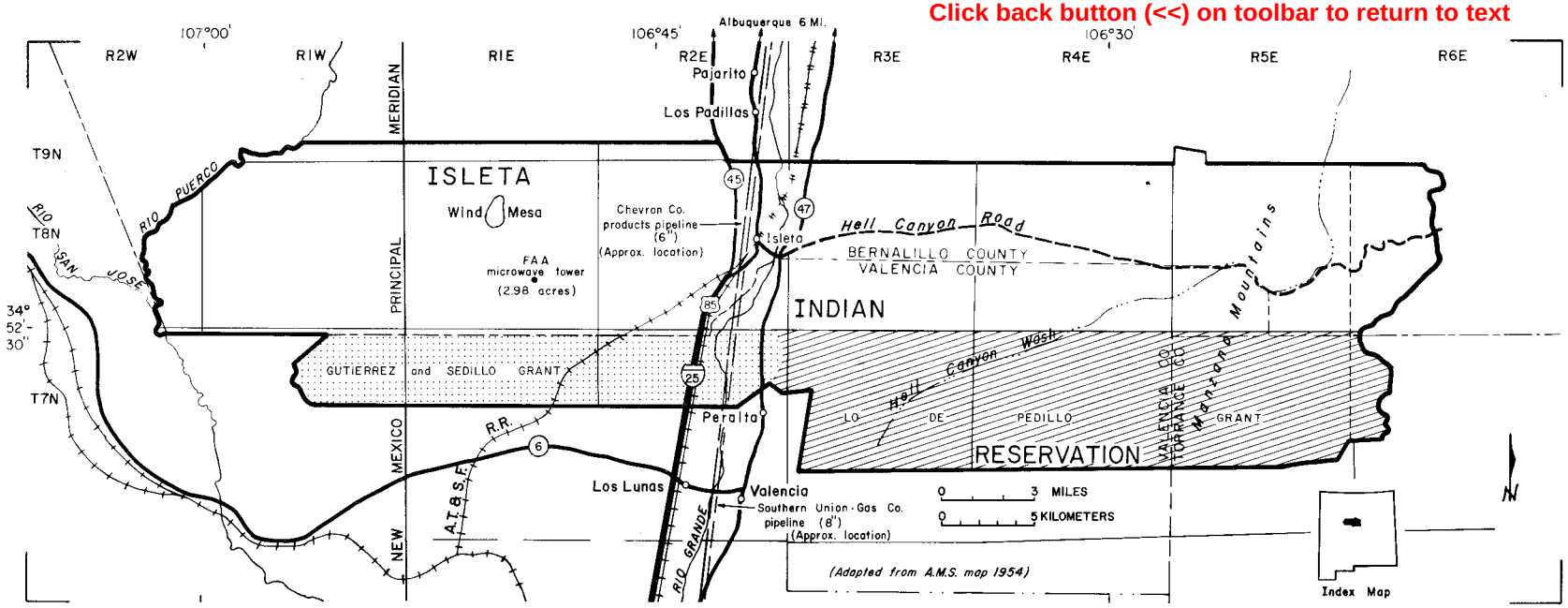

Figure 1. Index map showing infrastructure of Isleta Indian Reservation.

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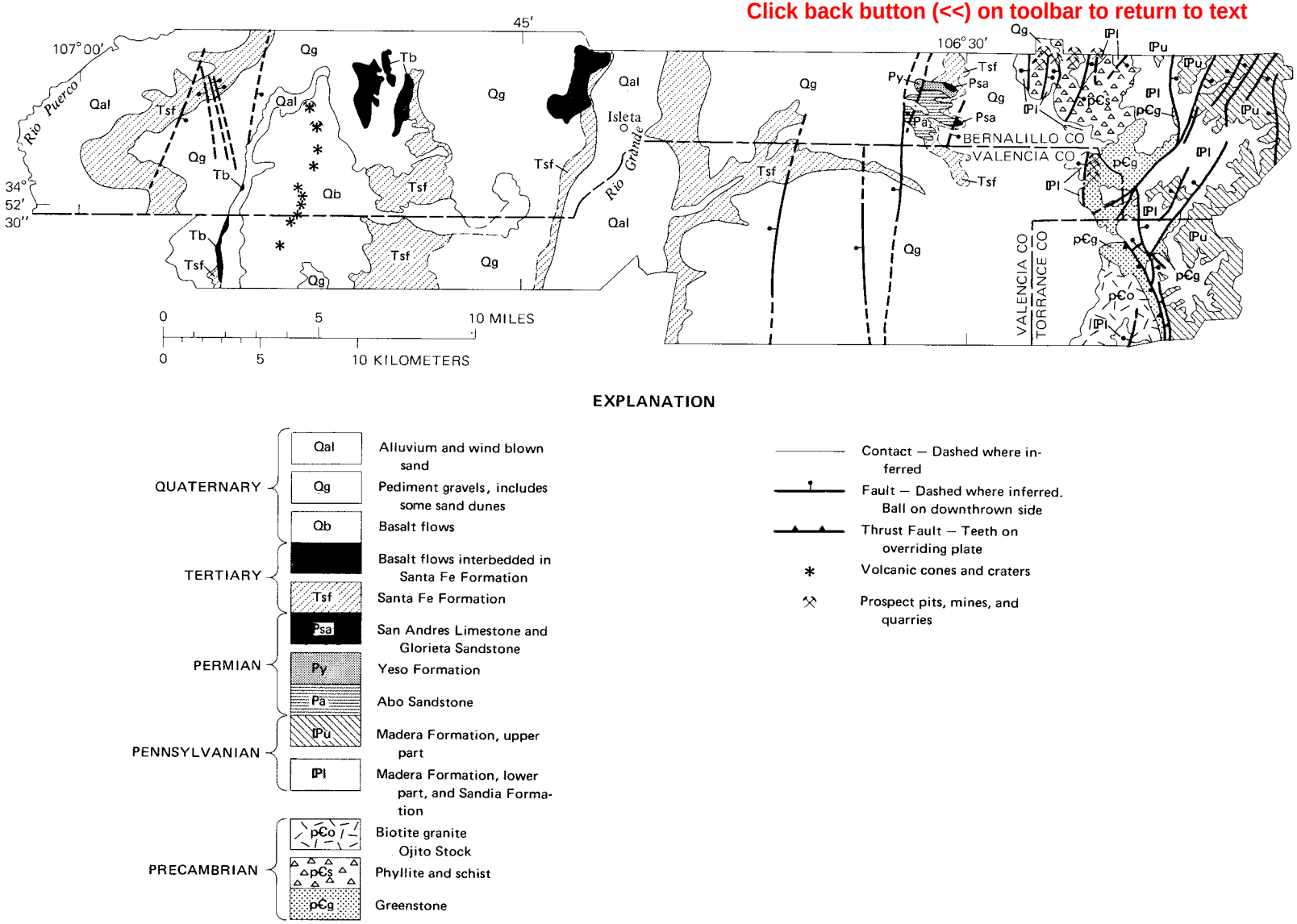

Figure 2. Geologic map of Isleta Indian Reservation (compiled from Reich, 1949, Wright, 1946, and Myers and McKay, 1970).

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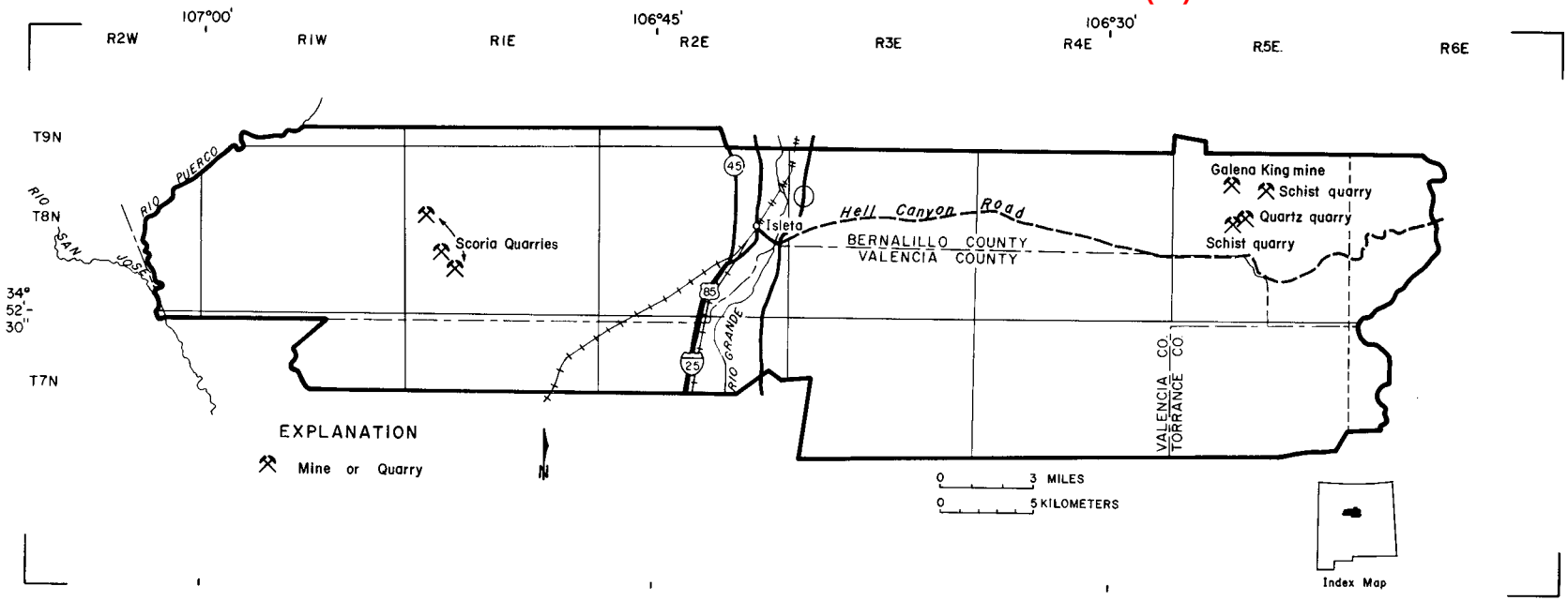

Figure 3. Map showing nonmetallic mineral resources, Isleta Indian Reservation.

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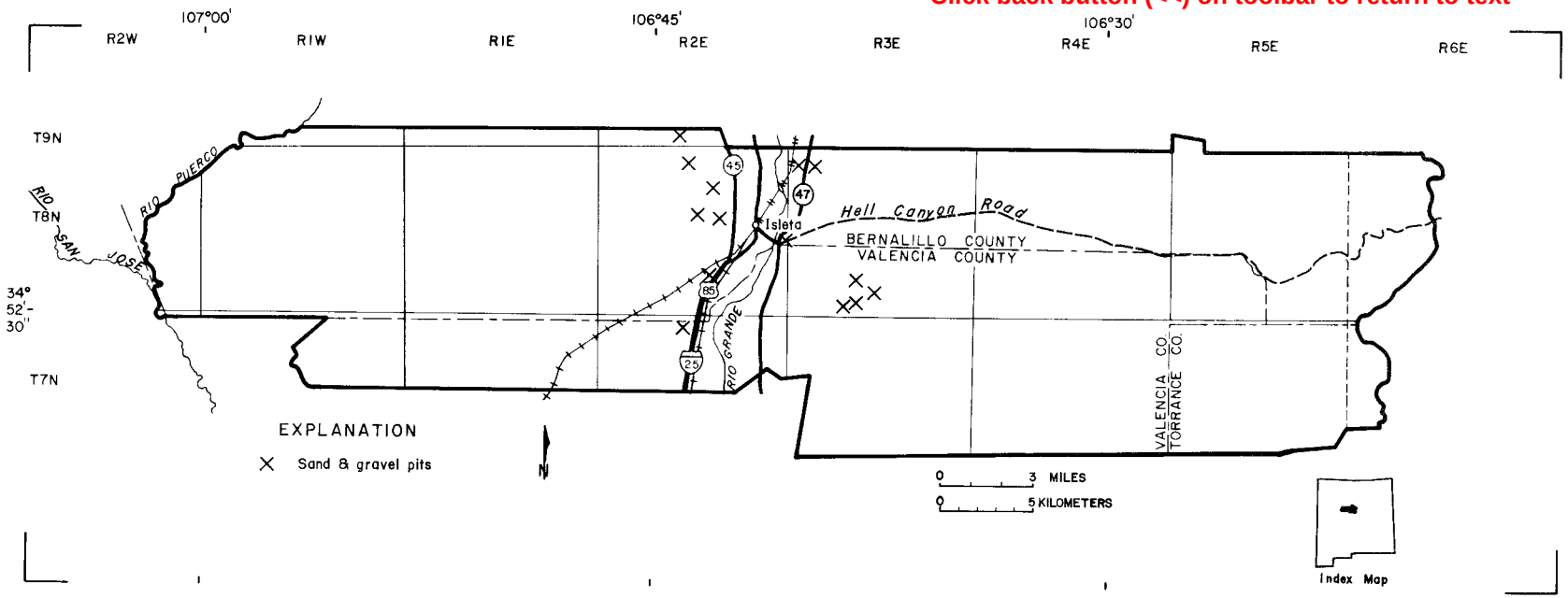

Figure 4. Map showing sand and gravel pits, Isleta Indian Reservation.

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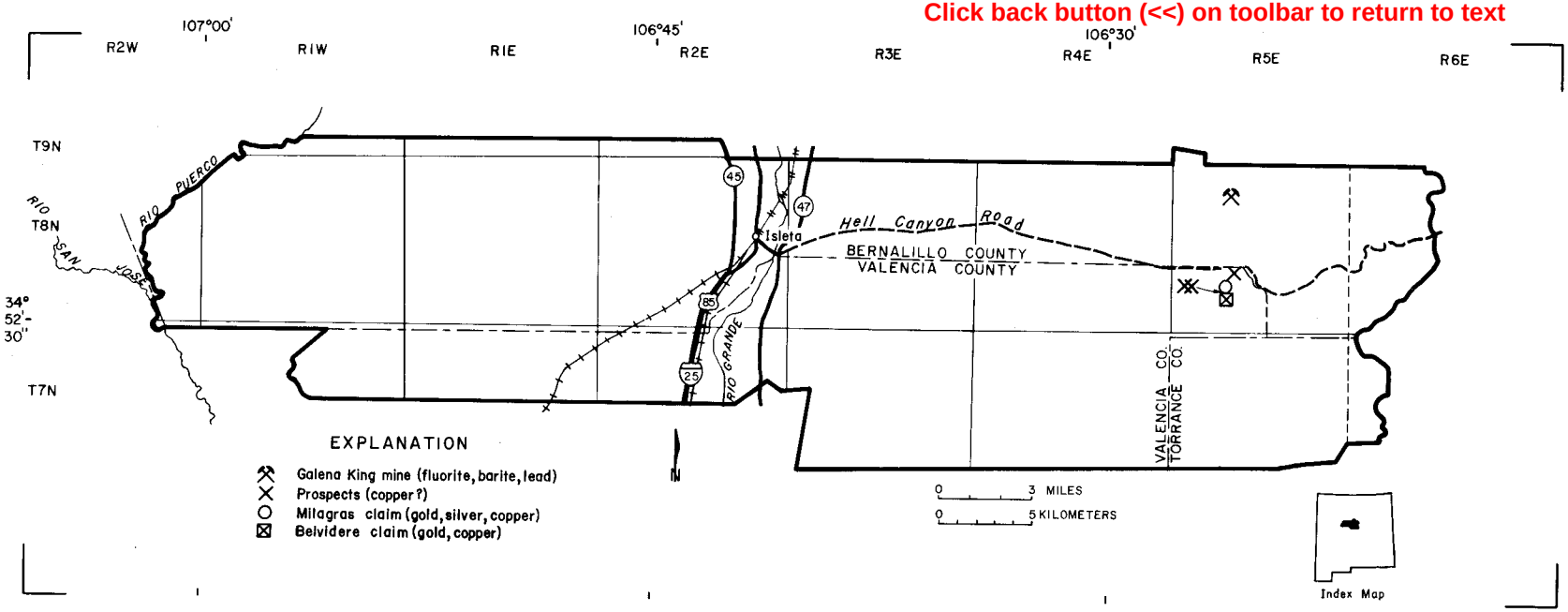

Figure 5. Map showing metallic mineral deposits, Isleta Indian Reservation.